Telonic

MODEL SM-2000

revised CALIBRATION PROCEDURE

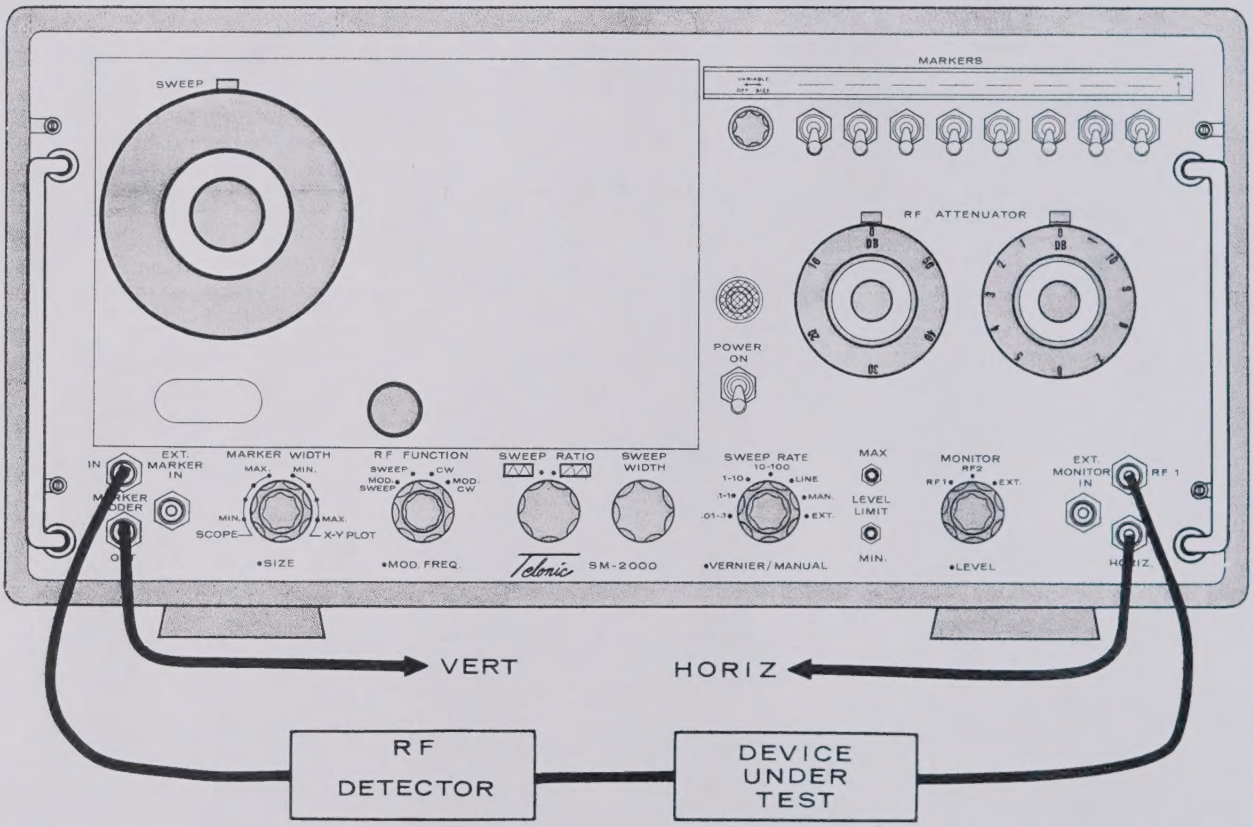
This booklet contains a revised and simplified calibration procedure for The Telonic Model SM-2000 sweep/signal generator control chassis.

This is the procedure as it will appear in future editions of the Instruction Maual. The procedure appearing in previous editions although valid was difficult to apply, particularly as concerns the "Vari-rate" circuit which generates the variable-rate sweep drive.

Additional copies are available to our customers and representatives on request.

SECTION II
OPERATING INSTRUCTIONS

TYPICAL SETUP



GENERAL

1. Plug in the RF oscillator for frequency range desired. Never plug in a unit while the power is on. Transient voltages may result in diode damage.

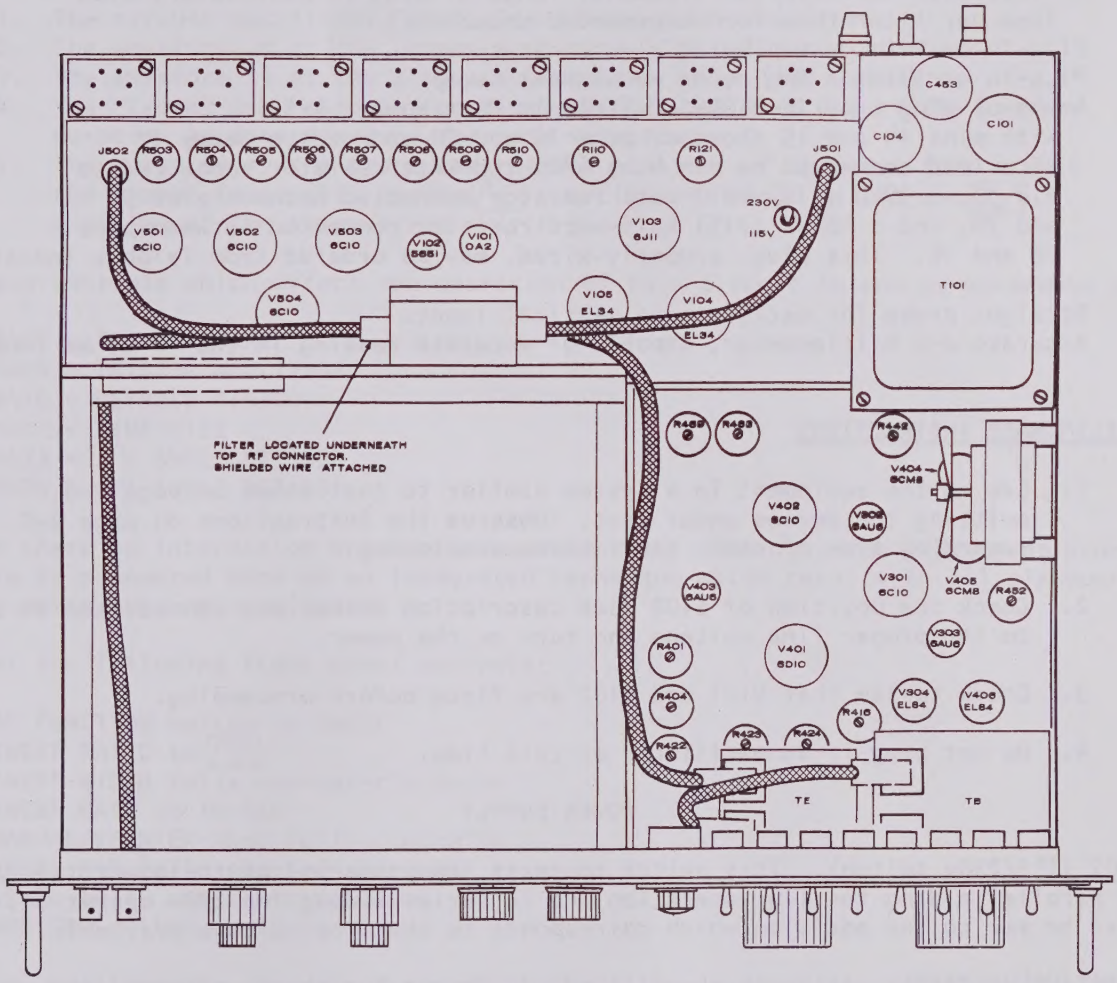
2. Make connections to the scope (or recorder), the device under test, and RF Detector as shown above. All connectors located on the sweep generator are BNC type. The cable that is used to connect the RF OUTPUT to the device under test should match the impedance of the sweep generator. If the input impedance of the device under test is different from the impedance of the sweep generator, a matching network should be used to insure a constant input signal. It is recommended that RG cable be used for all connections. This insures good ground connection between the devices and minimizes hum, leakage from the unit, and pickup of spurious external signals.

3. Make sure that S102 is set for the power line voltage available and plug in the line cord.

4. The versatility of the SM-2000 and the wide variety of plug-ins available make the listing of step-by-step operating procedures for all possible applications impossible. A study of the remainder of this section, in which the function of each panel control is discussed, will indicate clearly the control settings necessary in each particular application.

SECTION IV

CALIBRATION PROCEDURE



CHASSIS LAYOUT
Top View

GENERAL

EQUIPMENT REQUIRED

Accurate 20kΩ/v d-c voltmeter or vacuum-tube voltmeter
Good quality d-c oscilloscope with input impedance of 1MΩ or more
R-f detector suitable for frequency range of plug-in oscillators used (see our literature for recommended detectors)
Plug-in oscillator employing electronic sweep
Plug-in oscillator employing mechanical sweep
Amphenol plug type 26-4100-32P (Telonic Part Number S-39) with pins 14 and 15 shorted, pins 19 and 20 shorted, a heavy 1" wire lead connected to pin 4, a 680Ω two-watt resistor connected to pin 30, a 39kΩ (±1%) half-watt resistor connected between pins 5 and 29, and a 100kΩ (±1%) half-watt resistor connected between pins 29 and 16. This plug, properly wired, may be ordered from Telonic Industries, Inc.
Straight probe for oscilloscope vertical input.
Accurate d-c milliammeter, capable of accurate reading in the 18-20 ma range.

PRELIMINARY INSTRUCTIONS

1. Set up the equipment in a system similar to that shown on page 2-0, omitting the device under test. Observe the instructions on page 2-0 regarding type of cable and impedance matching.

2. Check the position of S102 (see description below) and connect the SM-2000 to the proper line voltage and turn on the power.

3. Check to see that V101 and V102 are fired before proceeding.

4. Do not plug in an oscillator at this time.

POWER SUPPLY

S102 (115/230v switch). This switch connects the primaries of the power transformer in parallel aiding for 115v operation and in series aiding for 230v operation. It must be set to the position which corresponds to the line voltage available.

NEGATIVE VOLTAGES. Although there is no adjustment for these voltages, the stability of the positive voltages depends on the stability of the reference voltage established by V101 and V102 and the adjustment ranges of the B+2 and B+3 control circuits depend on the actual value of this reference, nominally -87v. For these reasons both B-1 and B-2 should be checked each time the power supply is adjusted.

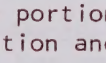
Connect the voltmeter from J601-13 (B-2) to ground. The voltage read should be -87v. Connect the voltmeter from J601-12 (B-1) to ground. The voltage read should be about -150v. If either voltage is unstable or outside the voltage range specified by the tube manufacturer, or if either tube is not fired, replace the tube(s). If the trouble persists, check for other trouble in the power supply. If the readings are normal, proceed with the B+2 and B+3 adjustments.

B+2 (R110). Connect the voltmeter from J601-4 to ground. Adjust R110 for a reading of +175v.

B+3 (R121). Connect the voltmeter from J601-5 to ground. Adjust R121 for a reading of +100v.

VARIABLE RATE CIRCUIT

When the six internal controls in the variable rate circuit are properly adjusted, the following conditions obtain:

1. The circuit oscillates, producing a triangular wave form.
2. The waveform is of the proper amplitude (100 volts peak-to-peak).
3. The waveform is at the proper average d-c level (+70 volts).
4. The "trace" and "retrace" portions of the wave form are of the proper duration as determined by the rate selected.
5. The duration of the trace and retrace portions of the wave form are in the proper ratio (1:1 in the position and about 9:1 in the  position of the sweep ratio switch.)

The six controls which affect the operation of this circuit in one or more ways are:

R401 - TRIGGER BIAS
R404 - TRIGGER AMPLITUDE
R416 - RETRACE PERIOD
R422 - LINE SIZE
R423 - /\ SWEEP PERIOD
R424 - /\ SWEEP PERIOD

Since there is interaction between several of these controls, the adjustment procedure is presented here as an integrated technique which results in all six controls being correctly adjusted.

Preset the following front panel controls:

RF FUNCTION switch to SWEEP
SWEEP RATIO to
SWEEP WIDTH fully counter-clockwise
SWEEP RATE to 10-100
MANUAL/VERNIER knob fully clockwise
LEVEL MIN fully counter-clockwise
LEVEL fully counter-clockwise
MONITOR switch to RF 1

Set the oscilloscope controls for a 10 cm 20-millisecond horizontal scale (2 milliseconds per centimeter) and a 20 v/cm vertical scale.

Plug in an oscillator in the "L" (electronically swept) series. Connect the probe to J601-28.

The remainder of the adjustment procedure for the variable rate circuit is divided into Parts A and B. If a triangular wave form is present at this point omit Part A and perform the adjustments in Part B only.

CALIBRATION PROCEDURE

Part A. Preset the following internal controls:

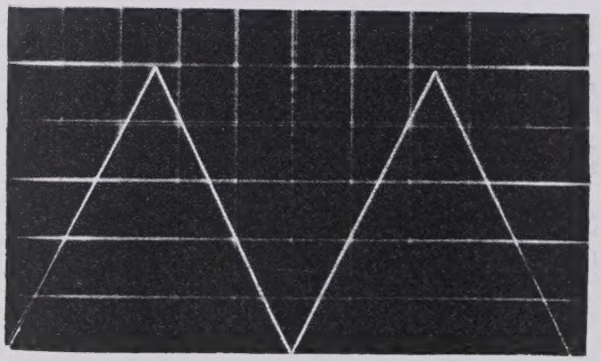
Both SWEEP PERIOD controls to mid-range
RETRACE PERIOD to mid-range
TRIGGER AMPLITUDE fully counter-clockwise
TRIGGER BIAS fully counter-clockwise

The oscilloscope should indicate a d-c potential of about +150v. Turn the TRIGGER BIAS control clockwise until the neon bulbs nearby start to glow. The d-c potential at J601-28 should drop to about +5v. Turn the TRIGGER BIAS control counter-clockwise until the neon lamps just go out. The d-c voltage at J601-28 should return to +150v. Now turn the TRIGGER AMPLITUDE control clockwise until the bulbs begin to glow again. A triangular wave form should appear on the oscilloscope.

If the neon bulbs fail to go out when the TRIGGER BIAS control is fully counter-clockwise, leave it in this position and turn the TRIGGER AMPLITUDE control clockwise while observing the oscilloscope until a triangular waveform appears.

Part B. Adjust TRIGGER BIAS for a d-c level (half-way between peaks) of +70v. Adjust TRIGGER AMPLITUDE for 100v peak-to-peak wave form. Since these two controls interact, readjustment of each may be necessary before the waveform is at both the proper amplitude (100 volts peak-to-peak) and the proper d-c voltage (+70v). Unless the oscilloscope is known to be calibrated accurately on this scale the d-c level should be verified with a good quality d-c voltmeter having a high input impedance. The voltmeter must be "average-responding"; i.e., the meter must respond to the average d-c level of the wave form.

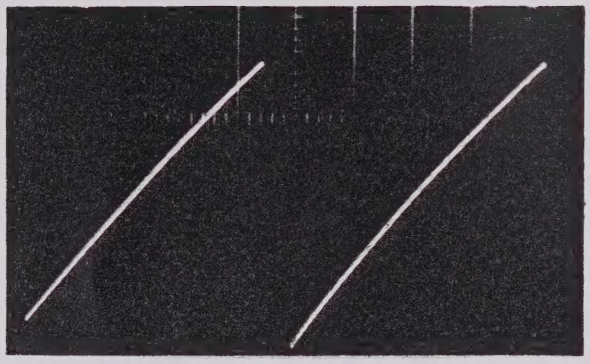
Adjust /\ SWEEP PERIOD for a 5-millisecond duration of the positive-going portion of the waveform. Adjust RETRACE PERIOD for a 5-millisecond duration of the negative-going portion of the waveform.



Correctly adjusted waveform in the /\/\ position. Oscilloscope and SM-2000 controls set as prescribed in text. Slight non-linearity in the oscilloscope compresses the cycle on the right.

Set the front panel SWEEP RATE switch in the LINE position. Adjust LINE SIZE for a 100-volt peak-to-peak wave form.

Return the SWEEP RATE switch to the 10-100 position and set the front panel SWEEP RATIO switch to the /\/\ position. Adjust /\ SWEEP PERIOD to provide a 10-millisecond total duration of the sawtooth cycle.



Correctly adjusted waveform in the ⊿⊿ position.

This concludes adjustment of the variable-rate circuit.

REACTOR DRIVE

As the front panel SWEEP WIDTH control is varied between maximum and minimum sweep widths, it is necessary that the d-c potential at the wiper arm be closely controlled, as this voltage determines the average, or "centering," current through V406, the reactor drive tube. This is determined at maximum and minimum sweep widths by the settings of R463 and R469 (CENT MAX SWEEP and CENT MIN SWEEP) respectively. The proper settings will provide slightly more centering current at maximum sweep width than at minimum, as most plug-ins operate more satisfactorily under this condition.

With the SM-2000 power OFF, insert the "dummy" Amphenol 26-4100-32P plug in the 32-contact socket, J601. The wiring of this plug is described under EQUIPMENT REQUIRED in this section. Connect the ammeter between Pin 4 and the resistor connected to Pin 30. MAKE SURE THE AMMETER REMAINS CONNECTED AT ANY TIME THE POWER IS ON.

Preset the following front panel controls:

SWEEP WIDTH fully counter-clockwise
SWEEP RATIO to ⊿⊿
RF FUNCTION switch to SWEEP
SWEEP RATE to 10-100
LEVEL fully counter-clockwise
MONITOR to RF 1

Before proceeding with the adjustment of R463 and R469 turn on the power, allow a 15-minute warmup period, and check the B+3 voltage again. It should be set to exactly +100v using the most accurate measuring standard available.

After B+3 is set correctly, adjust CENT MIN SWEEP (R469) for a reading of 18 ma on the ammeter. Rotate SWEEP WIDTH fully clockwise and adjust CENT MAX SWEEP (R463) for a reading of 20 ma on the ammeter.

Turn off the power, remove the dummy plug, plug in an oscillator, and reconnect the setup as in the figure on Page 2-0, omitting the device under test. Turn on the power.

MODULATION CIRCUIT

The frequency of the 1kc square wave with which the output is modulated in the MOD SWEEP and MOD CW modes is determined by the RC time of the coupling capacitors in series with R451 and R452. R452 is a coarse frequency control, which is set to bring the desired 1kc modulation frequency to approximately the mid-range position of R451, the vernier front panel control.

Preset MOD FREQ VERNIER (R451) on the front panel to mid-range and the RF FUNCTION Switch to MOD CW.

Connect the probe from the vertical input of the oscilloscope to J601-31.

Adjust R452 (MOD FREQ LIMIT) for exactly 20 cycles on the scope (two cycles per centimeter).

60-CYCLE GENERATOR
(Used with Mechanical Sweep Drive Only)

The BLANKING PHASE Control in the mechanically swept plug-ins and C413 in the SM-2000 form an a-c voltage divider and phase shifting network. The phase of the signal fed to the grid of V404A is determined by the setting of the BLANKING PHASE Control. This setting is covered in the manuals for the individual plug-ins.

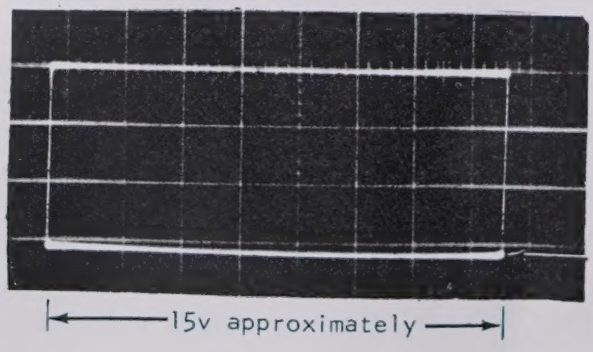
The bias on V404A is set by adjusting R442, BLANKING WIDTH. The proper bias provides approximately equal periods for the negative and positive portions of the squared output.

A mechanically swept plug-in oscillator must be used in adjusting the BLANKING WIDTH control.

Preset the following controls:

RF FUNCTION to SWEEP
MONITOR to RF 1
LEVEL Control fully clockwise
Attenuators both in 0 db position
Oscilloscope controls for externally-supplied horizontal deflection voltage

Connect the RF 1 (or RF 2) output through an RF detector to the vertical input of the scope. A rectangular pattern should appear.

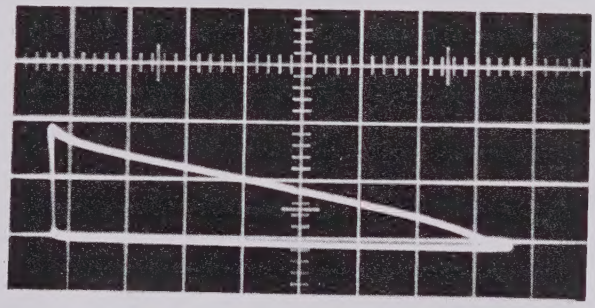


Equal to peak r-f output multiplied by detector efficiency

Adjust scope vertical and horizontal sensitivity controls to present a pattern as shown. Pattern will deflect up or down depending on output polarity of the r-f detector. Patterns shown are with Telonic half-wave detector having a negative output. A vertical line indicates no horizontal output. First check the oscilloscope and connecting cables, then trouble shoot the horizontal sweep section.

A horizontal line with zero amplitude indicates no RF output. First check the oscilloscope, r-f detector, level controls, and connecting cables. Then trouble shoot as prescribed in MAINTENANCE, Section V.

A horizontal line deflected below zero indicates no blanking. Trouble shoot the 60 cycle blanking generator. If pattern is not rectangular, adjust BLANKING WIDTH.



BLANKING WIDTH misadjusted

MARKER CIRCUIT

The MARKER SIZE Controls (R503 through R511) set the amplitude of the individual marker signals at the input to the birdy-by-pass amplifier system. They are set for optimum viewing of each marker. Perhaps the most common adjustment procedure would be that which results in equal amplitude for all markers, but these controls allow for emphasis of individual markers.

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